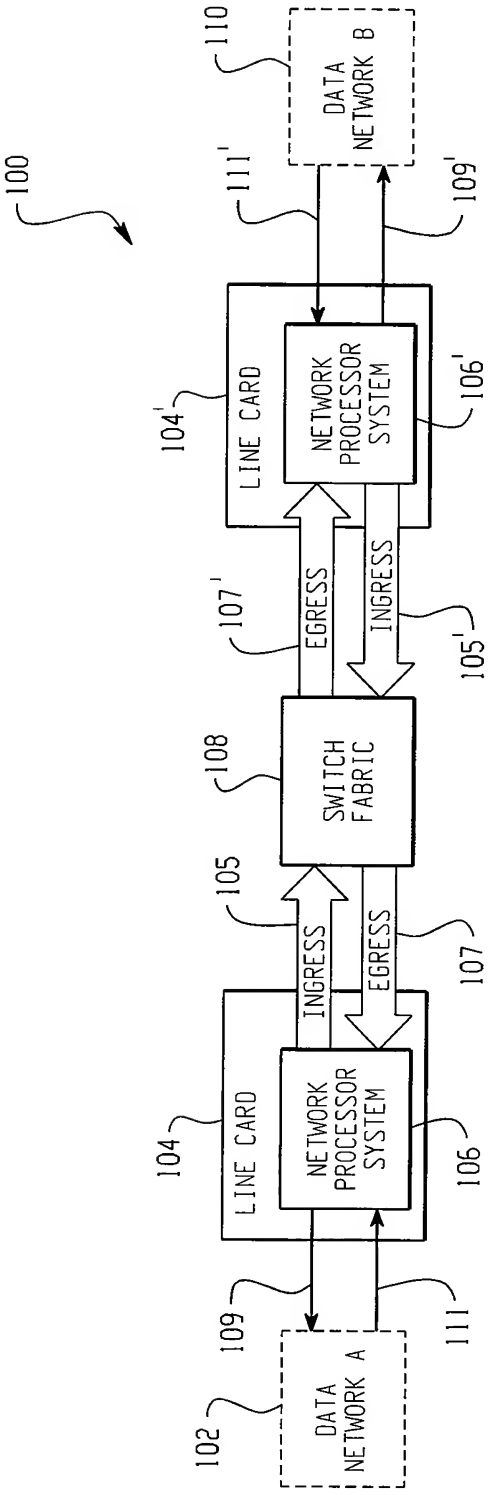
100
110
DATA NETWORK B
111'
109'
104'
LINE CARD
NETWORK PROCESSOR SYSTEM
106'
107'
EGRESS
INGRESS
105'
108
SWITCH FABRIC
105
INGRESS
EGRESS
107
104
LINE CARD
NETWORK PROCESSOR SYSTEM
106
109
111
102
DATA NETWORK A

Fig. 1

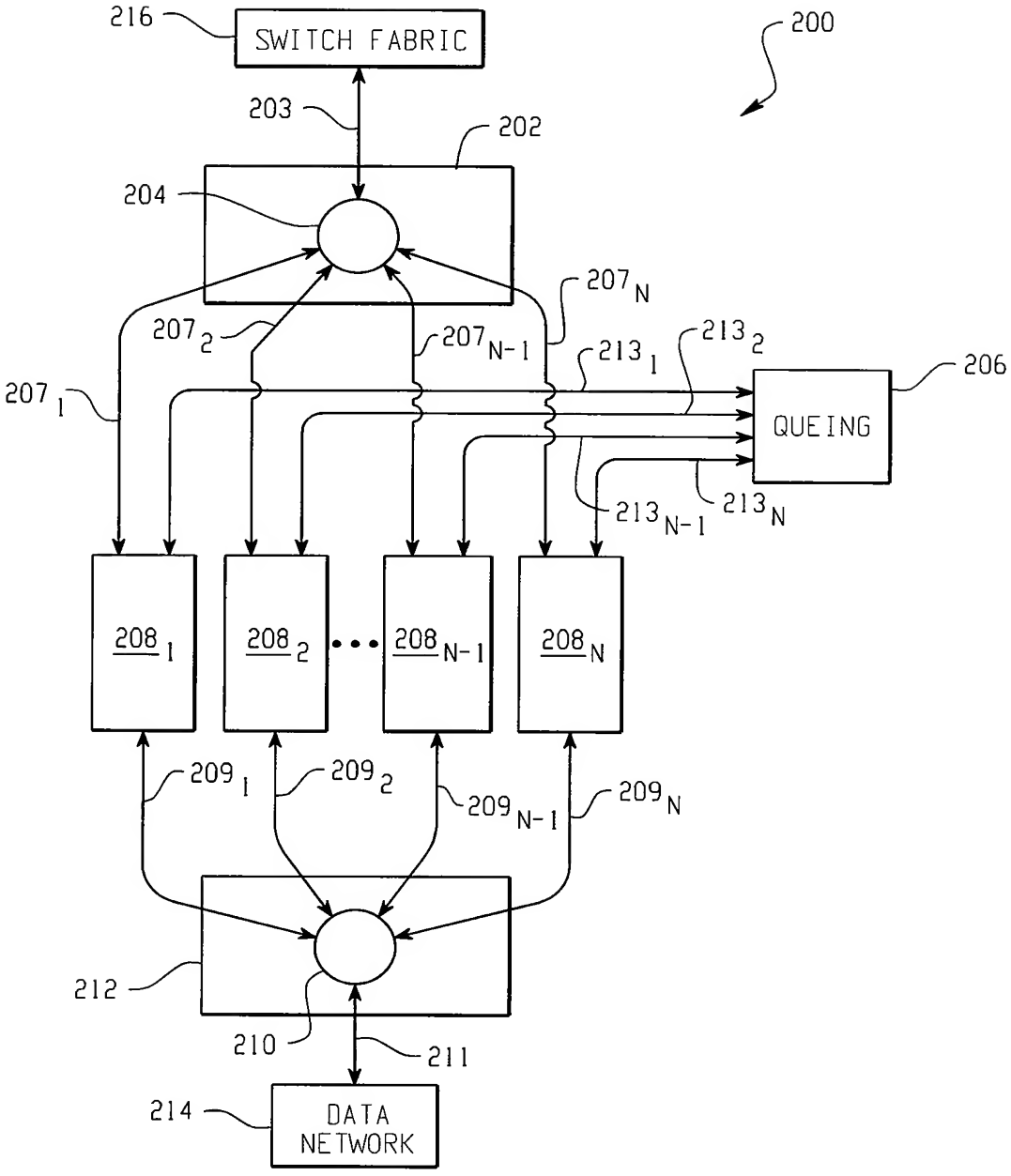
216
SWITCH FABRIC
200
203
202
204
207_N
207_2
207_{N-1}
213_1
213_2
206
207_1
QUEING
213_{N-1}
213_N
208_1
208_2
208_{N-1}
208_N
209_1
209_2
209_{N-1}
209_N
212
210
211
214
DATA NETWORK

Fig. 2

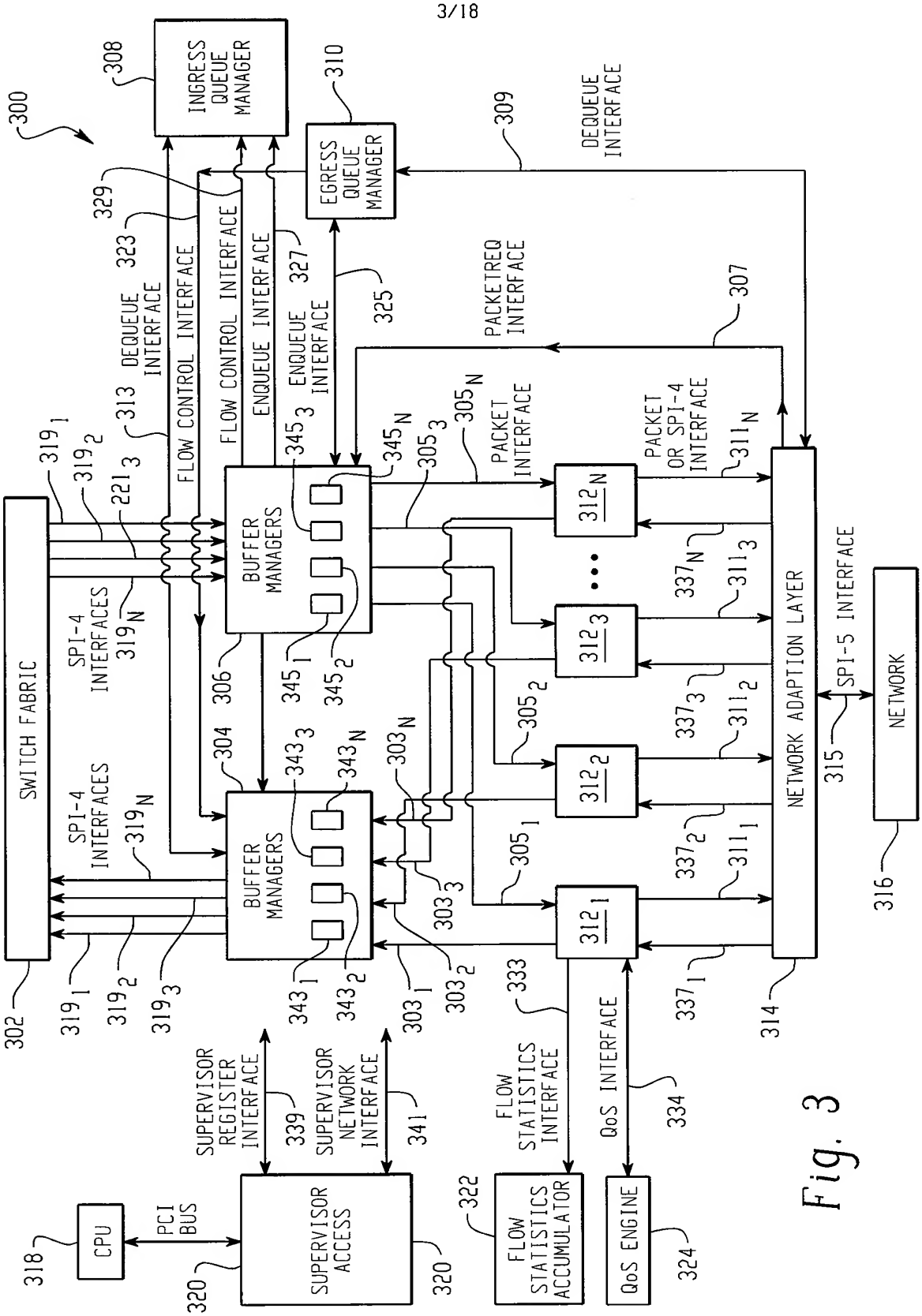
300
INGRESS QUEUE MANAGER
308
EGRESS QUEUE MANAGER
310
DEQUEUE INTERFACE
309
329
323
DEQUEUE INTERFACE
313
FLOW CONTROL INTERFACE
ENQUEUE INTERFACE
327
325
ENQUEUE INTERFACE
PACKETREQ INTERFACE
307
PACKET INTERFACE
PACKET OR SPI-4 INTERFACE
SWITCH FABRIC
SPI-4 INTERFACES
BUFFER MANAGERS
306
304
NETWORK ADAPTION LAYER
SPI-5 INTERFACE
NETWORK
315
316
302
314
SUPERVISOR REGISTER INTERFACE
339
SUPERVISOR NETWORK INTERFACE
341
FLOW STATISTICS INTERFACE
333
QoS INTERFACE
334
CPU
318
PCI BUS
320
SUPERVISOR ACCESS
FLOW STATISTICS ACCUMULATOR
322
QoS ENGINE
324

Fig. 3

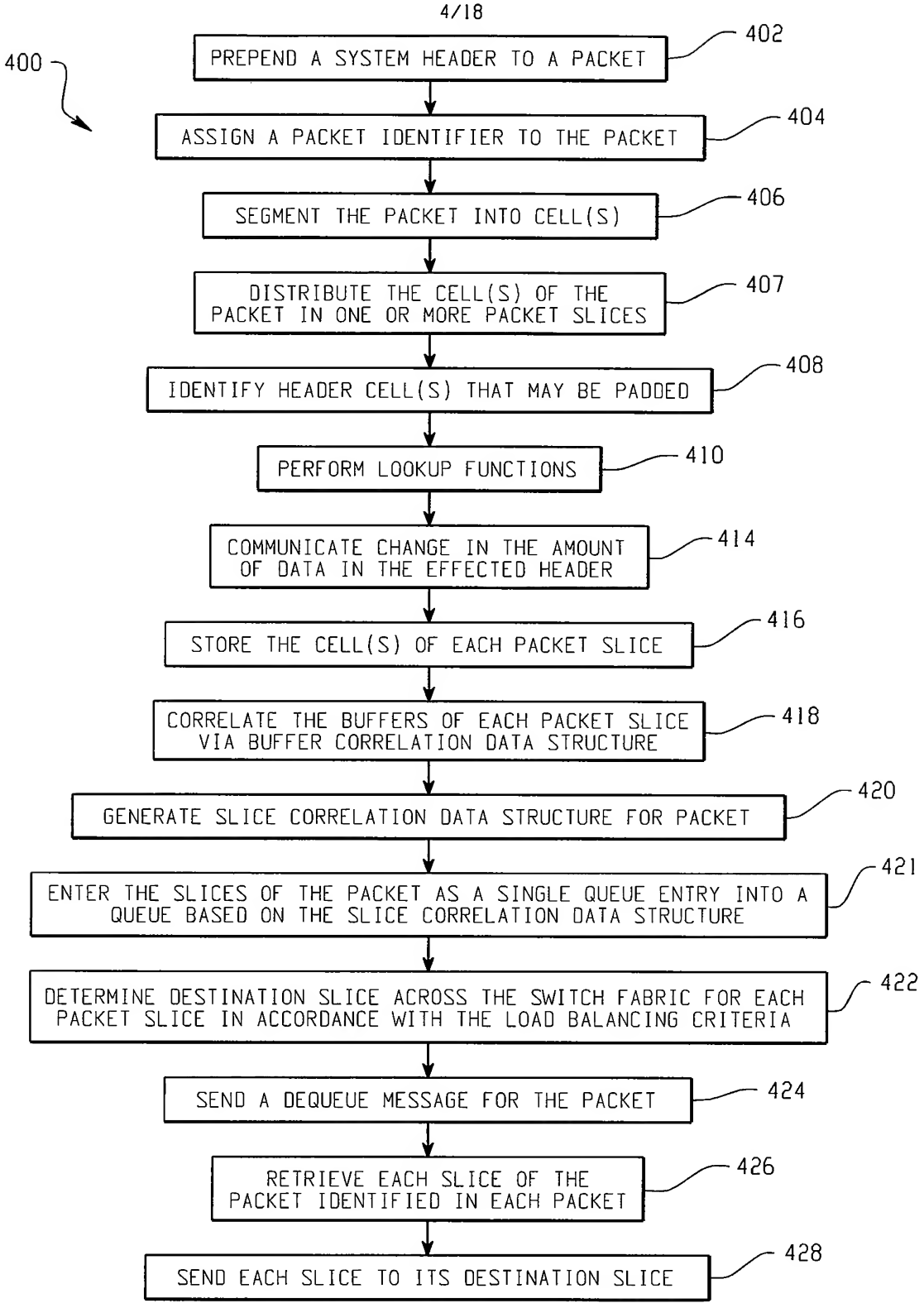
400
PREPEND A SYSTEM HEADER TO A PACKET
402
ASSIGN A PACKET IDENTIFIER TO THE PACKET
404
SEGMENT THE PACKET INTO CELL(S)
406
DISTRIBUTE THE CELL(S) OF THE PACKET IN ONE OR MORE PACKET SLICES
407
IDENTIFY HEADER CELL(S) THAT MAY BE PADDED
408
PERFORM LOOKUP FUNCTIONS
410
COMMUNICATE CHANGE IN THE AMOUNT OF DATA IN THE EFFECTED HEADER
414
STORE THE CELL(S) OF EACH PACKET SLICE
416
CORRELATE THE BUFFERS OF EACH PACKET SLICE VIA BUFFER CORRELATION DATA STRUCTURE
418
GENERATE SLICE CORRELATION DATA STRUCTURE FOR PACKET
420
ENTER THE SLICES OF THE PACKET AS A SINGLE QUEUE ENTRY INTO A QUEUE BASED ON THE SLICE CORRELATION DATA STRUCTURE
421
DETERMINE DESTINATION SLICE ACROSS THE SWITCH FABRIC FOR EACH PACKET SLICE IN ACCORDANCE WITH THE LOAD BALANCING CRITERIA
422
SEND A DEQUEUE MESSAGE FOR THE PACKET
424
RETRIEVE EACH SLICE OF THE PACKET IDENTIFIED IN EACH PACKET
426
SEND EACH SLICE TO ITS DESTINATION SLICE
428

Fig. 4A

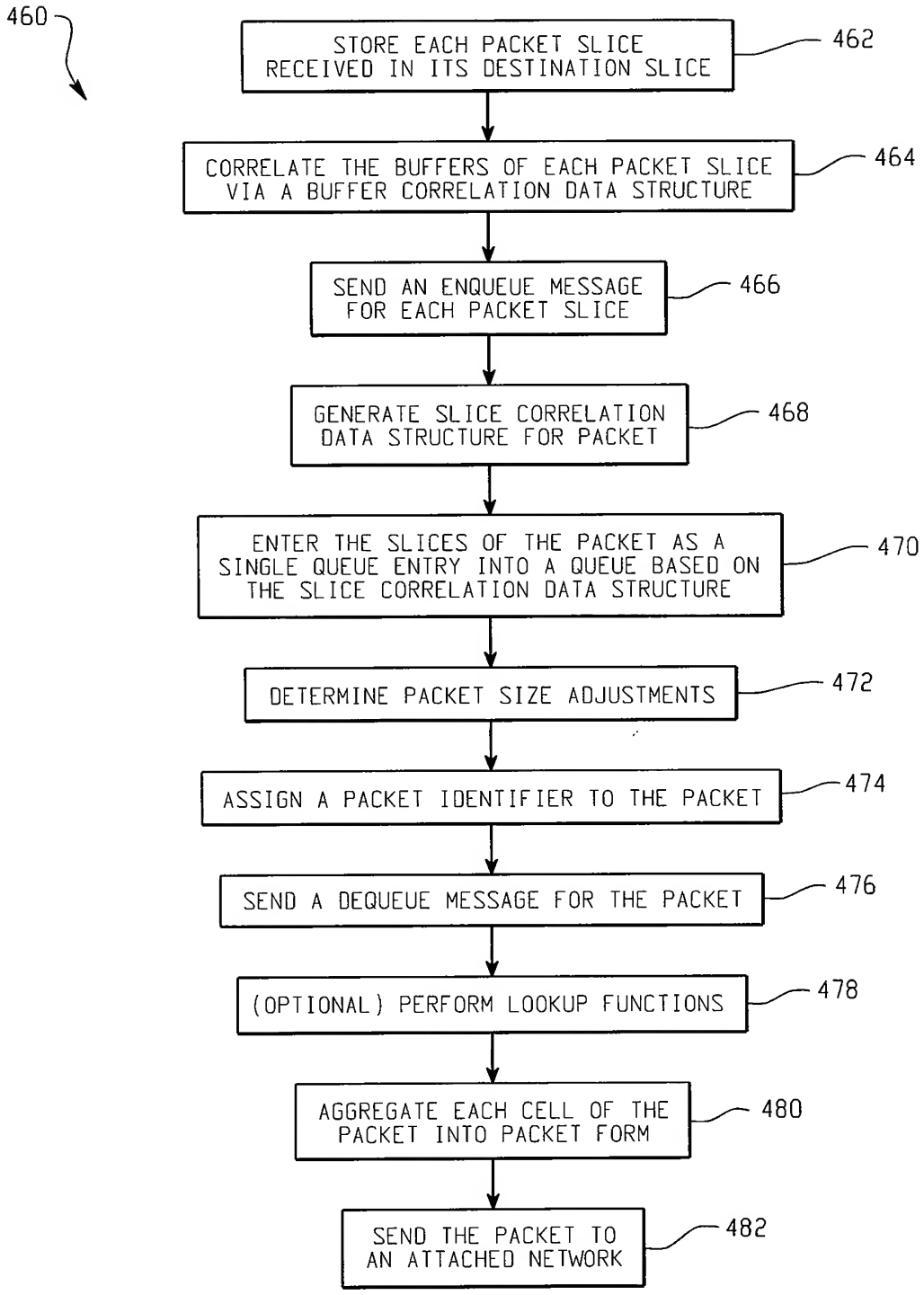
460
STORE EACH PACKET SLICE RECEIVED IN ITS DESTINATION SLICE
462
CORRELATE THE BUFFERS OF EACH PACKET SLICE VIA A BUFFER CORRELATION DATA STRUCTURE
464
SEND AN ENQUEUE MESSAGE FOR EACH PACKET SLICE
466
GENERATE SLICE CORRELATION DATA STRUCTURE FOR PACKET
468
ENTER THE SLICES OF THE PACKET AS A SINGLE QUEUE ENTRY INTO A QUEUE BASED ON THE SLICE CORRELATION DATA STRUCTURE
470
DETERMINE PACKET SIZE ADJUSTMENTS
472
ASSIGN A PACKET IDENTIFIER TO THE PACKET
474
SEND A DEQUEUE MESSAGE FOR THE PACKET
476
(OPTIONAL) PERFORM LOOKUP FUNCTIONS
478
AGGREGATE EACH CELL OF THE PACKET INTO PACKET FORM
480
SEND THE PACKET TO AN ATTACHED NETWORK
482

Fig. 4B

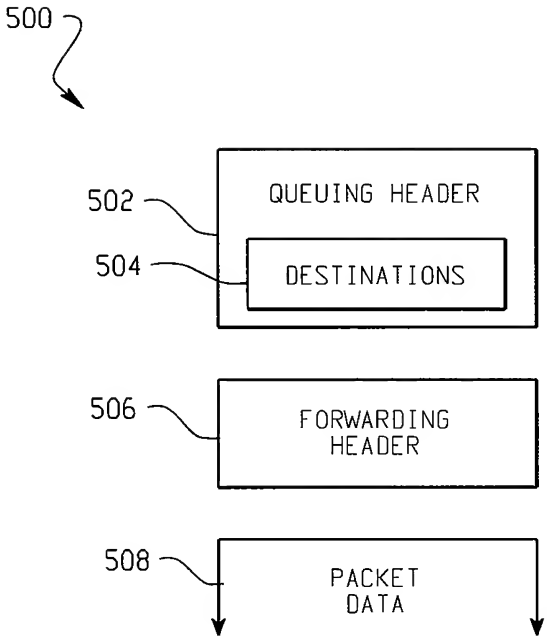
500
502
QUEUING HEADER
504
DESTINATIONS
506
FORWARDING HEADER
508
PACKET DATA

Fig. 5

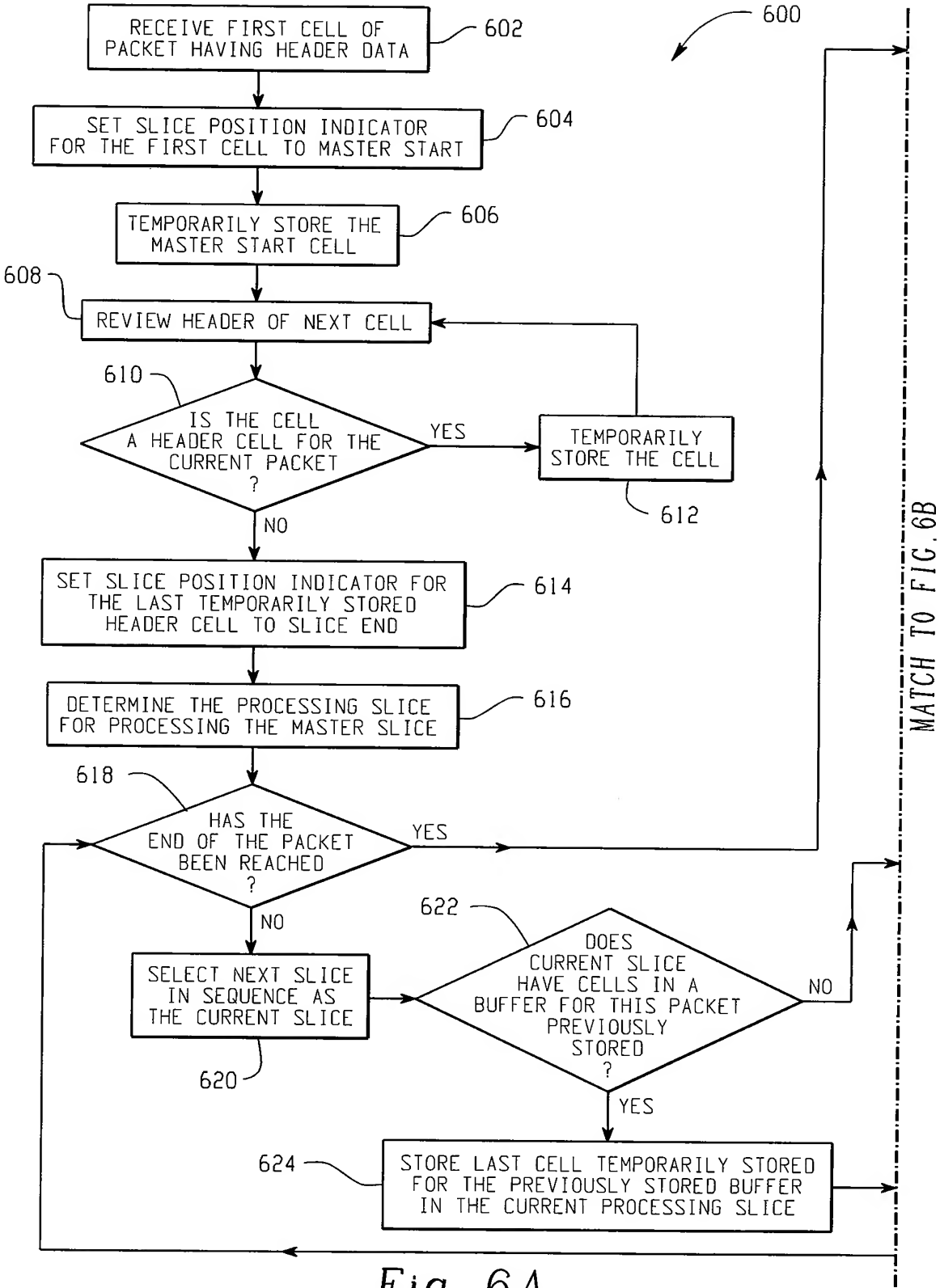
600
RECEIVE FIRST CELL OF PACKET HAVING HEADER DATA
602
SET SLICE POSITION INDICATOR FOR THE FIRST CELL TO MASTER START
604
TEMPORARILY STORE THE MASTER START CELL
606
608
REVIEW HEADER OF NEXT CELL
610
IS THE CELL A HEADER CELL FOR THE CURRENT PACKET ?
YES
TEMPORARILY STORE THE CELL
612
NO
SET SLICE POSITION INDICATOR FOR THE LAST TEMPORARILY STORED HEADER CELL TO SLICE END
614
DETERMINE THE PROCESSING SLICE FOR PROCESSING THE MASTER SLICE
616
618
HAS THE END OF THE PACKET BEEN REACHED ?
YES
NO
622
DOES CURRENT SLICE HAVE CELLS IN A BUFFER FOR THIS PACKET PREVIOUSLY STORED ?
NO
SELECT NEXT SLICE IN SEQUENCE AS THE CURRENT SLICE
620
YES
624
STORE LAST CELL TEMPORARILY STORED FOR THE PREVIOUSLY STORED BUFFER IN THE CURRENT PROCESSING SLICE
MATCH TO FIG. 6B

Fig. 6A

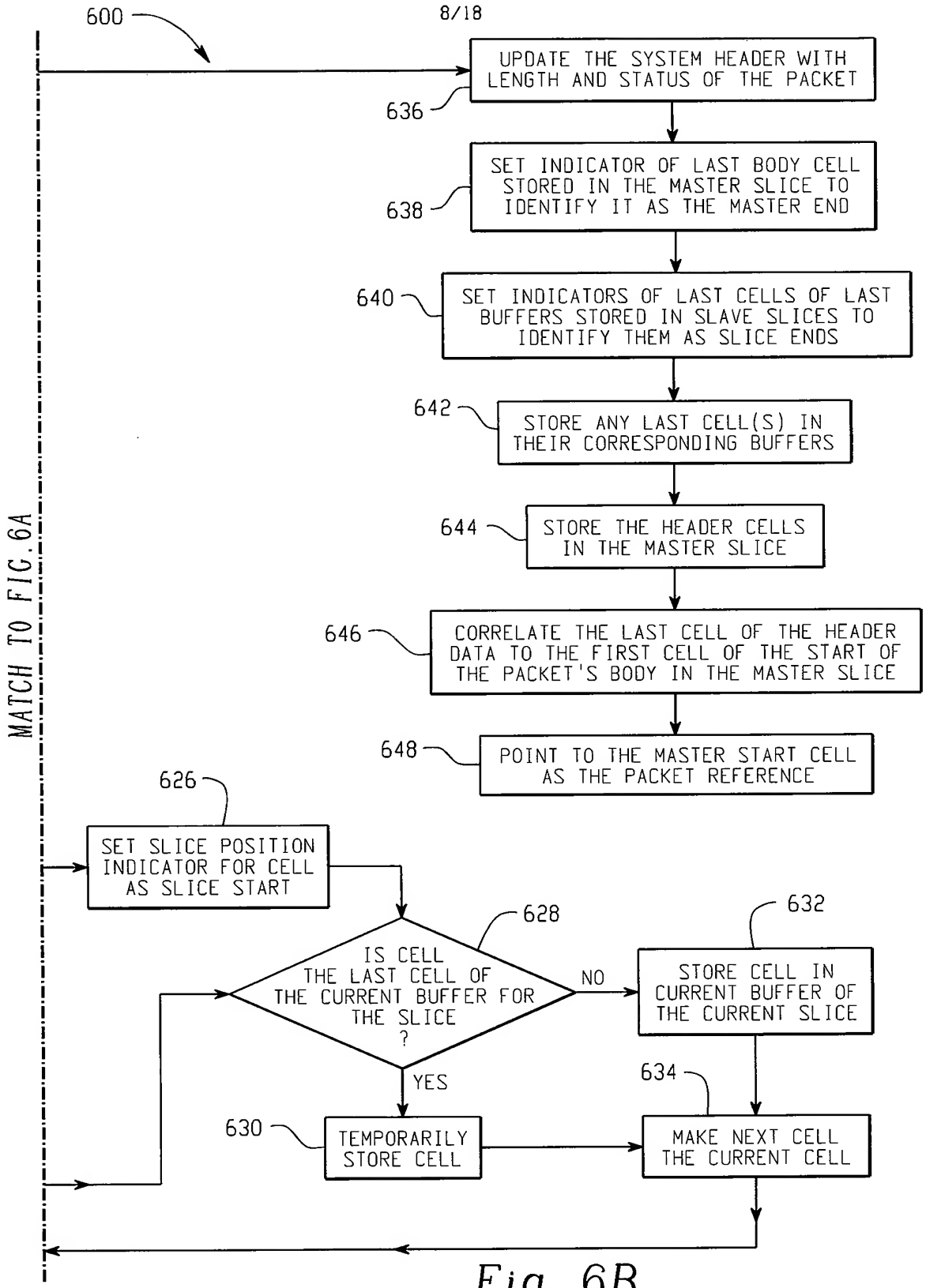
600
UPDATE THE SYSTEM HEADER WITH LENGTH AND STATUS OF THE PACKET
636
SET INDICATOR OF LAST BODY CELL STORED IN THE MASTER SLICE TO IDENTIFY IT AS THE MASTER END
638
SET INDICATORS OF LAST CELLS OF LAST BUFFERS STORED IN SLAVE SLICES TO IDENTIFY THEM AS SLICE ENDS
640
STORE ANY LAST CELL(S) IN THEIR CORRESPONDING BUFFERS
642
STORE THE HEADER CELLS IN THE MASTER SLICE
644
CORRELATE THE LAST CELL OF THE HEADER DATA TO THE FIRST CELL OF THE START OF THE PACKET'S BODY IN THE MASTER SLICE
646
POINT TO THE MASTER START CELL AS THE PACKET REFERENCE
648
MATCH TO FIG. 6A
626
SET SLICE POSITION INDICATOR FOR CELL AS SLICE START
628
IS CELL THE LAST CELL OF THE CURRENT BUFFER FOR THE SLICE ?
NO
632
STORE CELL IN CURRENT BUFFER OF THE CURRENT SLICE
YES
630
TEMPORARILY STORE CELL
634
MAKE NEXT CELL THE CURRENT CELL

Fig. 6B

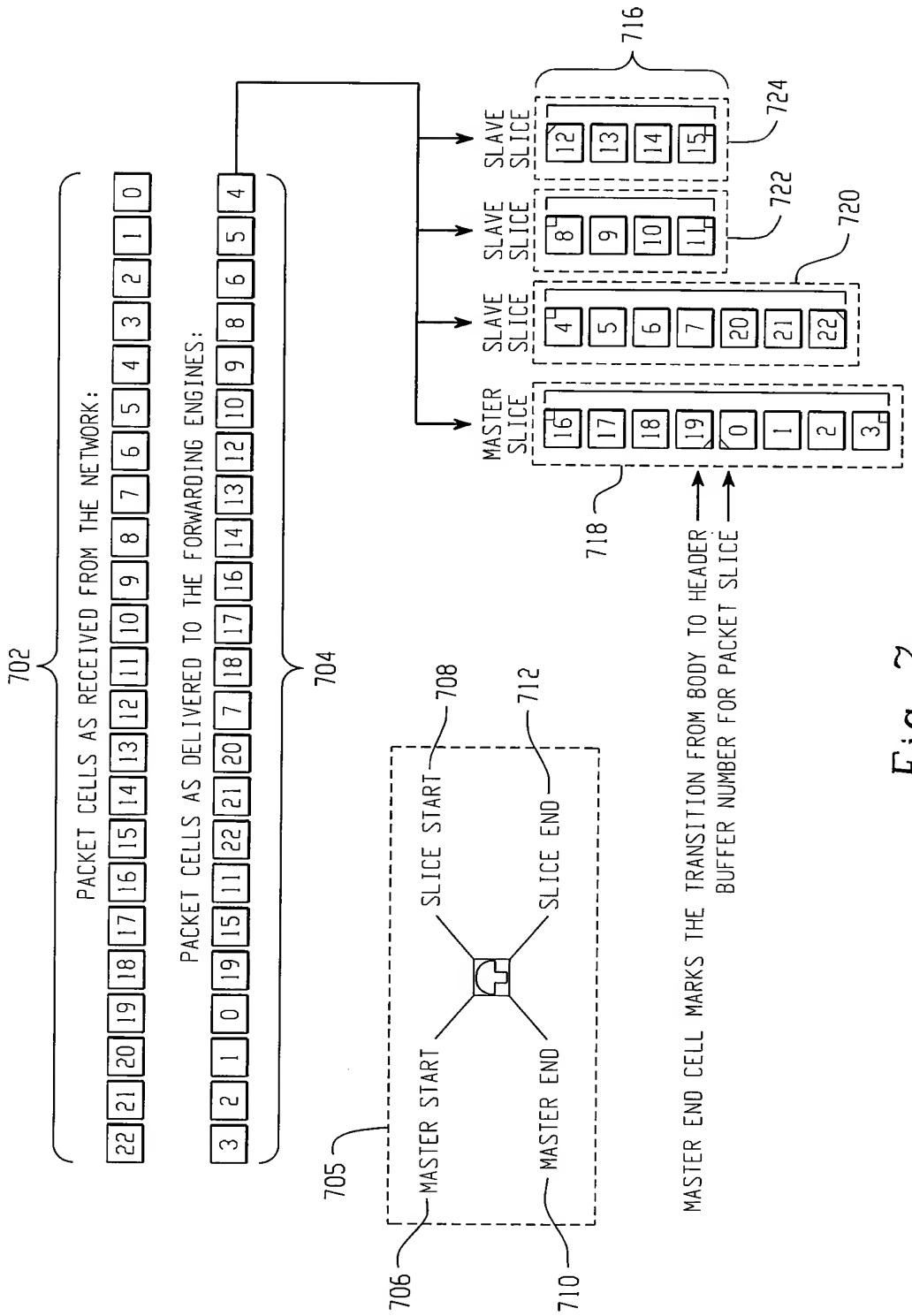
PACKET CELLS AS RECEIVED FROM THE NETWORK:
22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
PACKET CELLS AS DELIVERED TO THE FORWARDING ENGINES:
3 2 1 0 19 15 11 22 21 20 7 18 17 16 14 13 12 10 9 8 6 5 4
MASTER SLICE
16 17 18 19 0 1 2 3
SLAVE SLICE
4 5 6 7 20 21 22
SLAVE SLICE
8 9 10 11
SLAVE SLICE
12 13 14 15
MASTER START
SLICE START
SLICE END
MASTER END
MASTER END CELL MARKS THE TRANSITION FROM BODY TO HEADER
BUFFER NUMBER FOR PACKET SLICE
702
704
705
706
708
710
712
716
718
720
722
724

Fig. 7

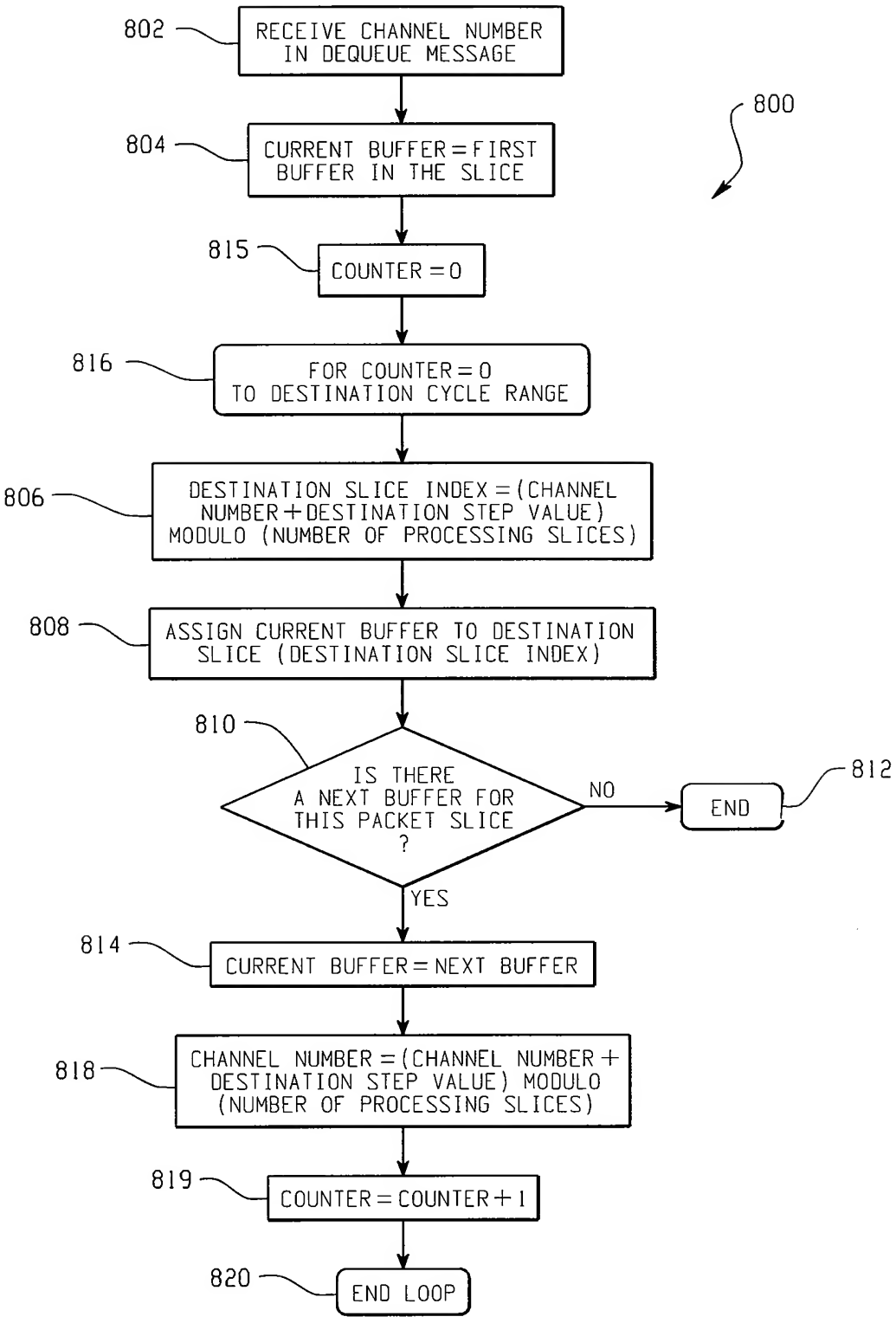
800
802
RECEIVE CHANNEL NUMBER IN DEQUEUE MESSAGE
804
CURRENT BUFFER = FIRST BUFFER IN THE SLICE
815
COUNTER = 0
816
FOR COUNTER = 0 TO DESTINATION CYCLE RANGE
806
DESTINATION SLICE INDEX = (CHANNEL NUMBER + DESTINATION STEP VALUE) MODULO (NUMBER OF PROCESSING SLICES)
808
ASSIGN CURRENT BUFFER TO DESTINATION SLICE (DESTINATION SLICE INDEX)
810
IS THERE A NEXT BUFFER FOR THIS PACKET SLICE ?
NO
812
END
YES
814
CURRENT BUFFER = NEXT BUFFER
818
CHANNEL NUMBER = (CHANNEL NUMBER + DESTINATION STEP VALUE) MODULO (NUMBER OF PROCESSING SLICES)
819
COUNTER = COUNTER + 1
820
END LOOP

Fig. 8

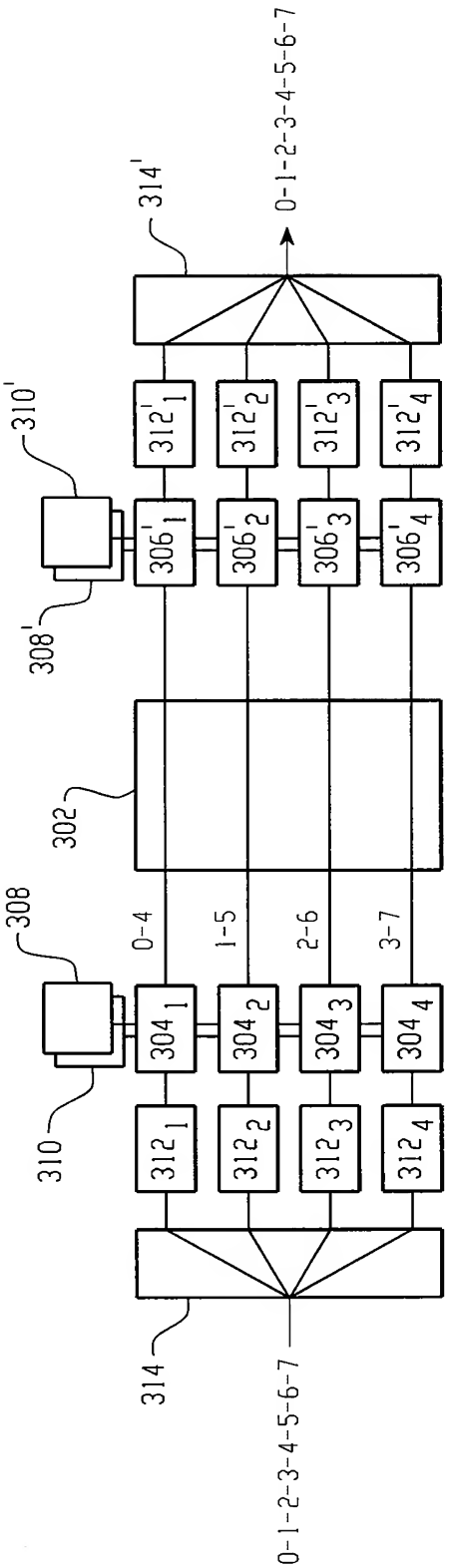
0-1-2-3-4-5-6-7
314'
310'
308'
302
308
310
0-4
1-5
2-6
3-7
314
0-1-2-3-4-5-6-7

Fig. 9A

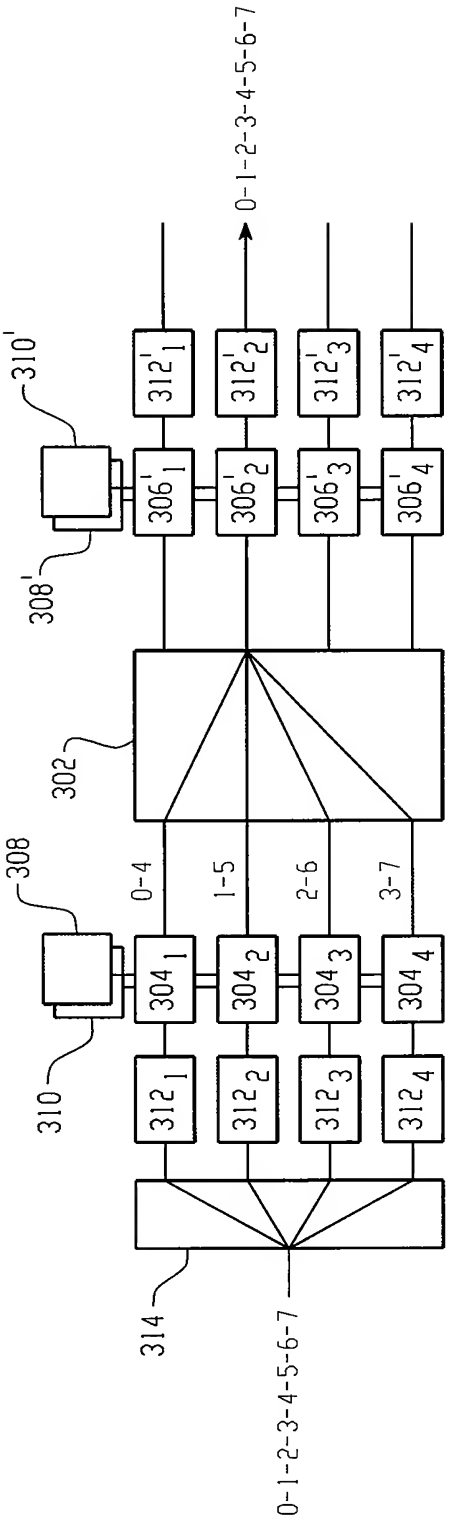
0-1-2-3-4-5-6-7
310'
308'
302
308
310
0-4
1-5
2-6
3-7
314
0-1-2-3-4-5-6-7

Fig. 9B

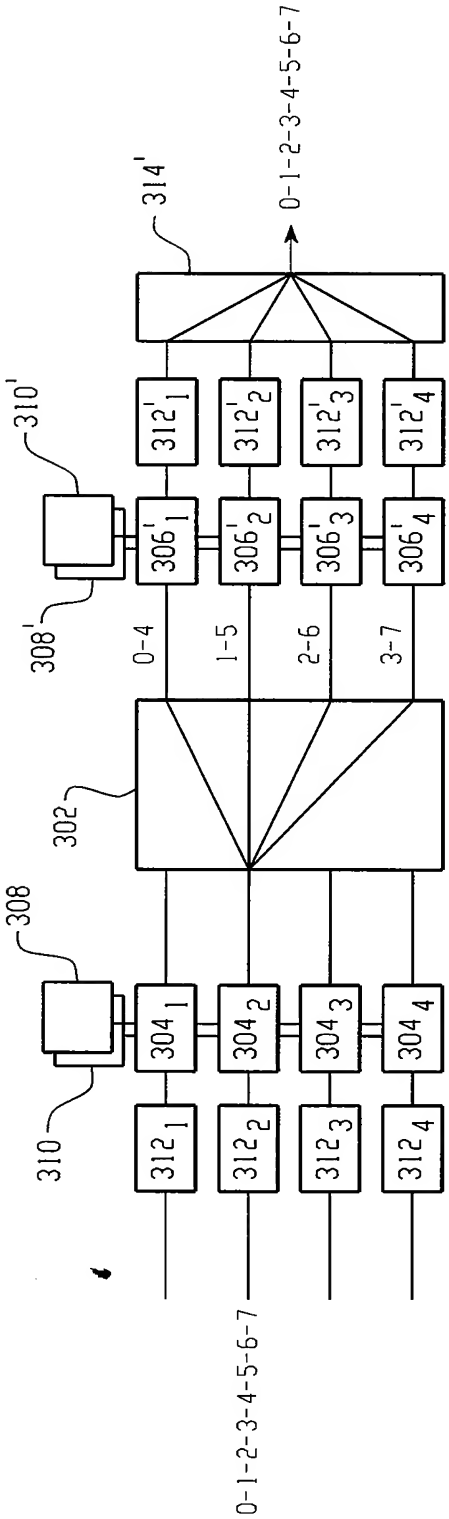
0-1-2-3-4-5-6-7
314'
310'
308'
0-4
1-5
2-6
3-7
302
308
310
0-1-2-3-4-5-6-7

Fig. 9C

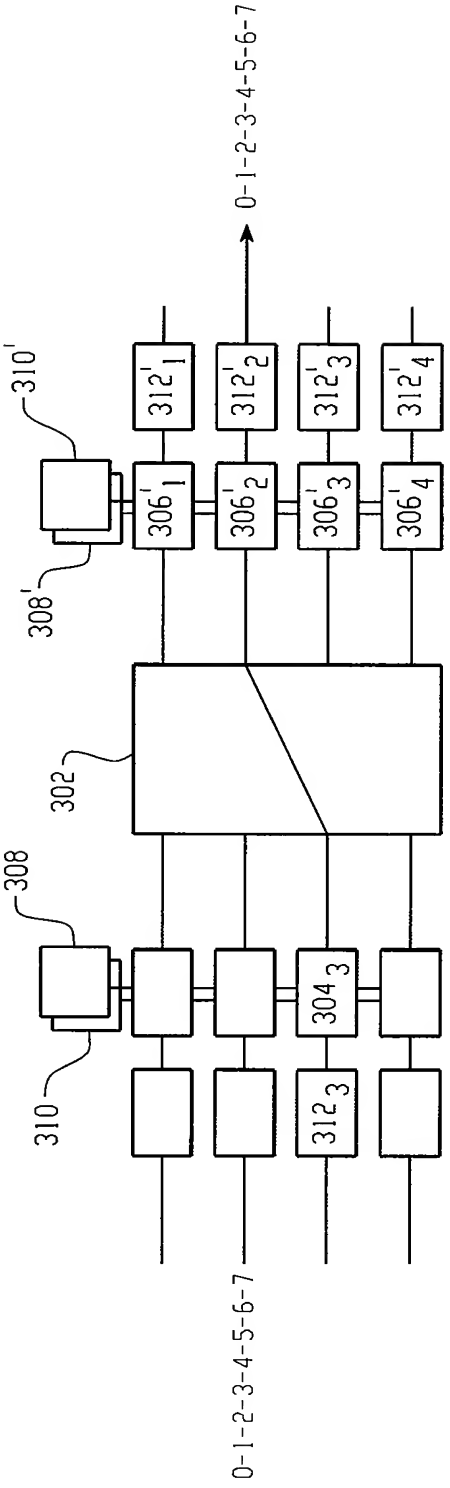
0-1-2-3-4-5-6-7
310'
308'
302
308
310
0-1-2-3-4-5-6-7

Fig. 9D

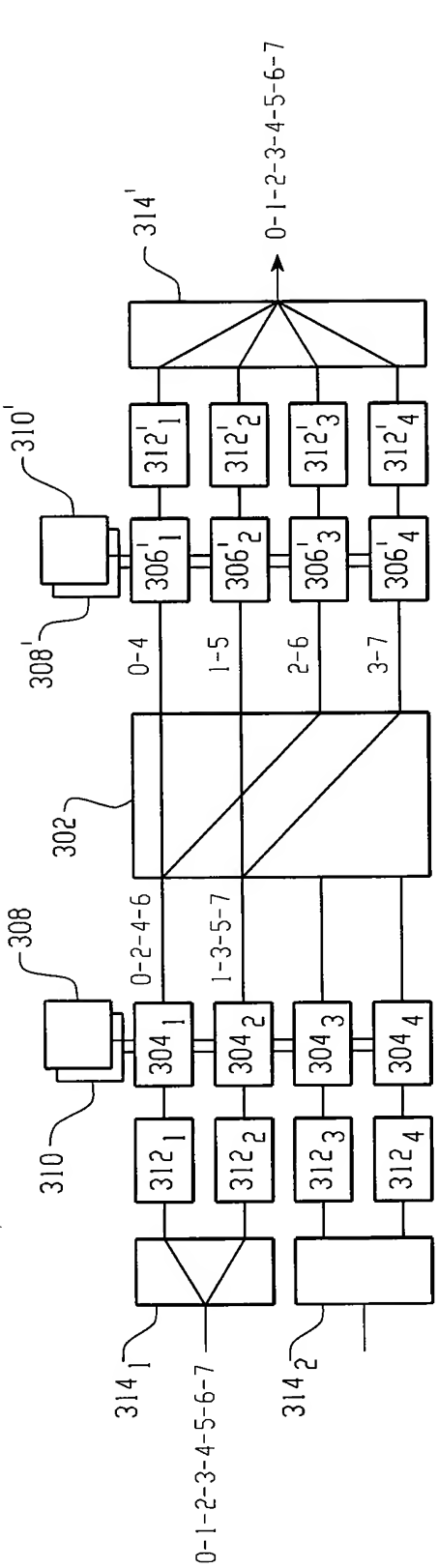
0-1-2-3-4-5-6-7
314'
310'
308'
306'1
306'2
306'3
306'4
312'1
312'2
312'3
312'4
0-4
1-5
2-6
3-7
302
0-2-4-6
1-3-5-7
308
310
304 1
304 2
304 3
304 4
312 1
312 2
312 3
312 4
314 1
314 2
0-1-2-3-4-5-6-7

Fig. 9E

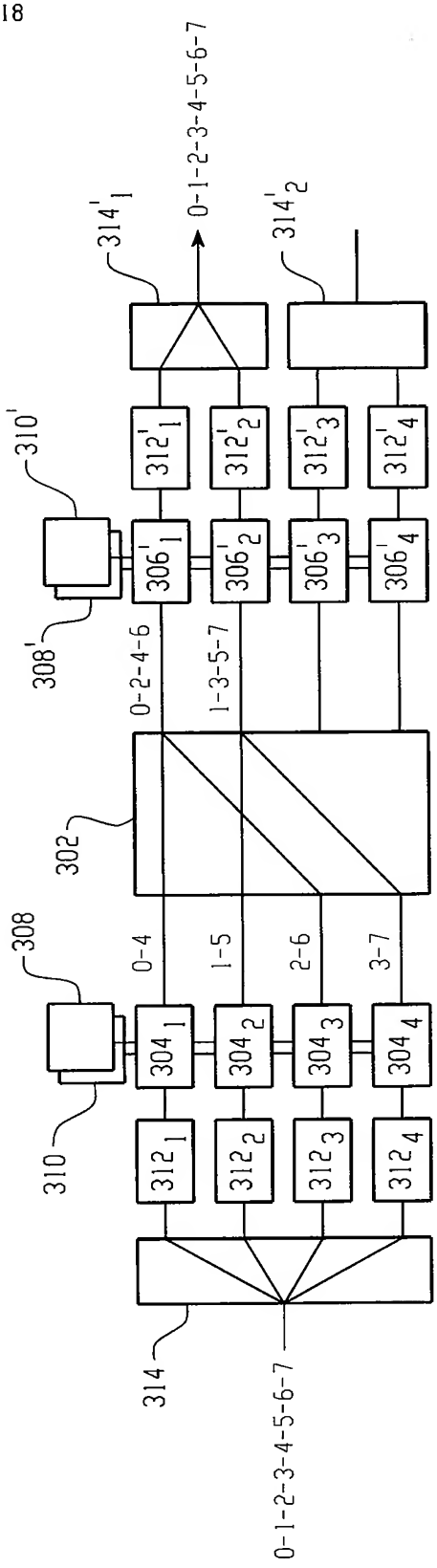
0-1-2-3-4-5-6-7
314'1
314'2
310'
308'
306'1
306'2
306'3
306'4
312'1
312'2
312'3
312'4
0-2-4-6
1-3-5-7
302
0-4
1-5
2-6
3-7
308
310
304 1
304 2
304 3
304 4
312 1
312 2
312 3
312 4
314
0-1-2-3-4-5-6-7

Fig. 9F

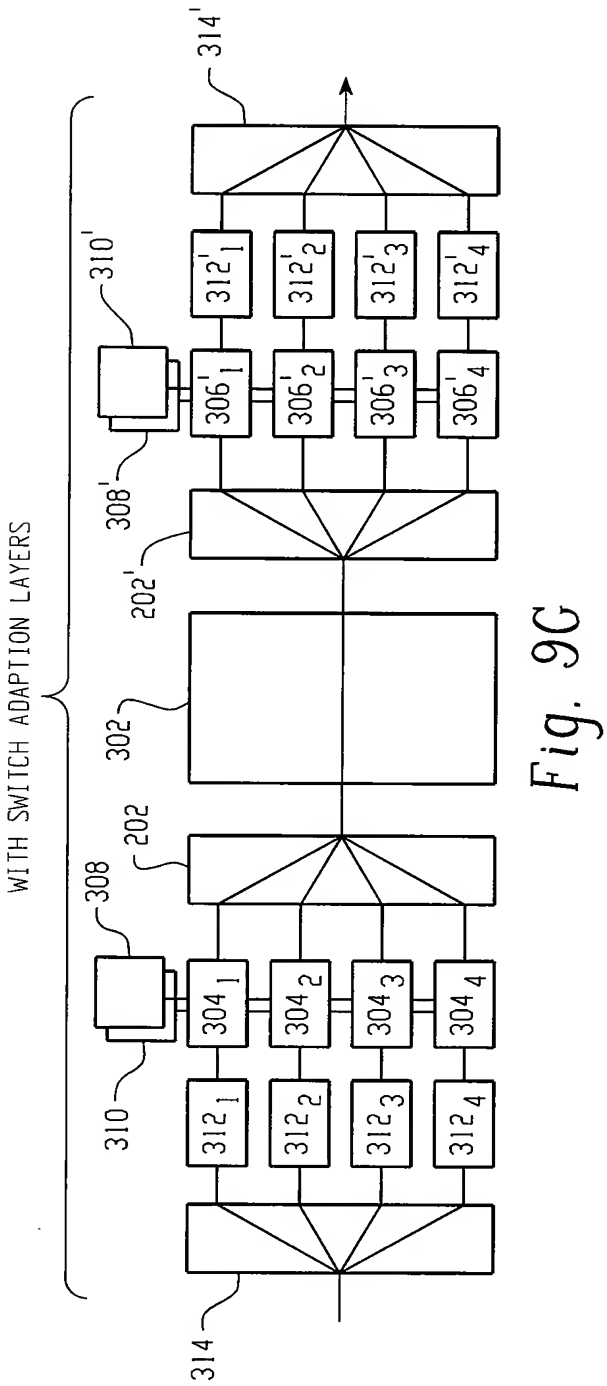
WITH SWITCH ADAPTION LAYERS
314'
310'
312'1
312'2
312'3
312'4
306'1
306'2
306'3
306'4
308'
202'
302
202
308
304 1
304 2
304 3
304 4
310
312 1
312 2
312 3
312 4
314

Fig. 9G

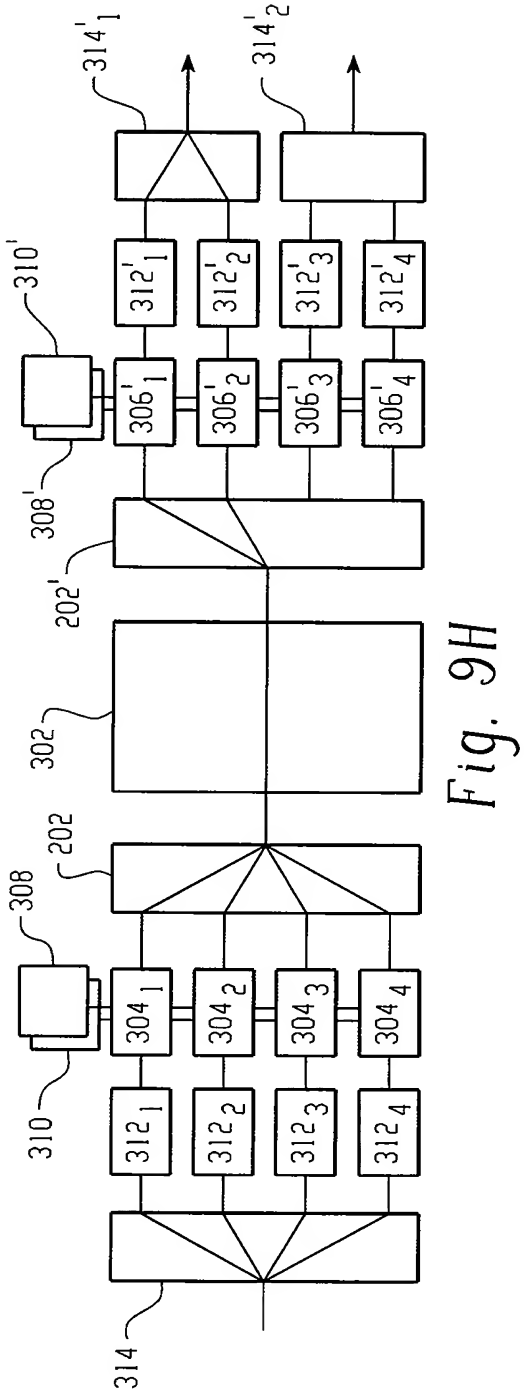
314'1
314'2
310'
312'1
312'2
312'3
312'4
306'1
306'2
306'3
306'4
308'
202'
302
202
308
304 1
304 2
304 3
304 4
310
312 1
312 2
312 3
312 4
314

Fig. 9H

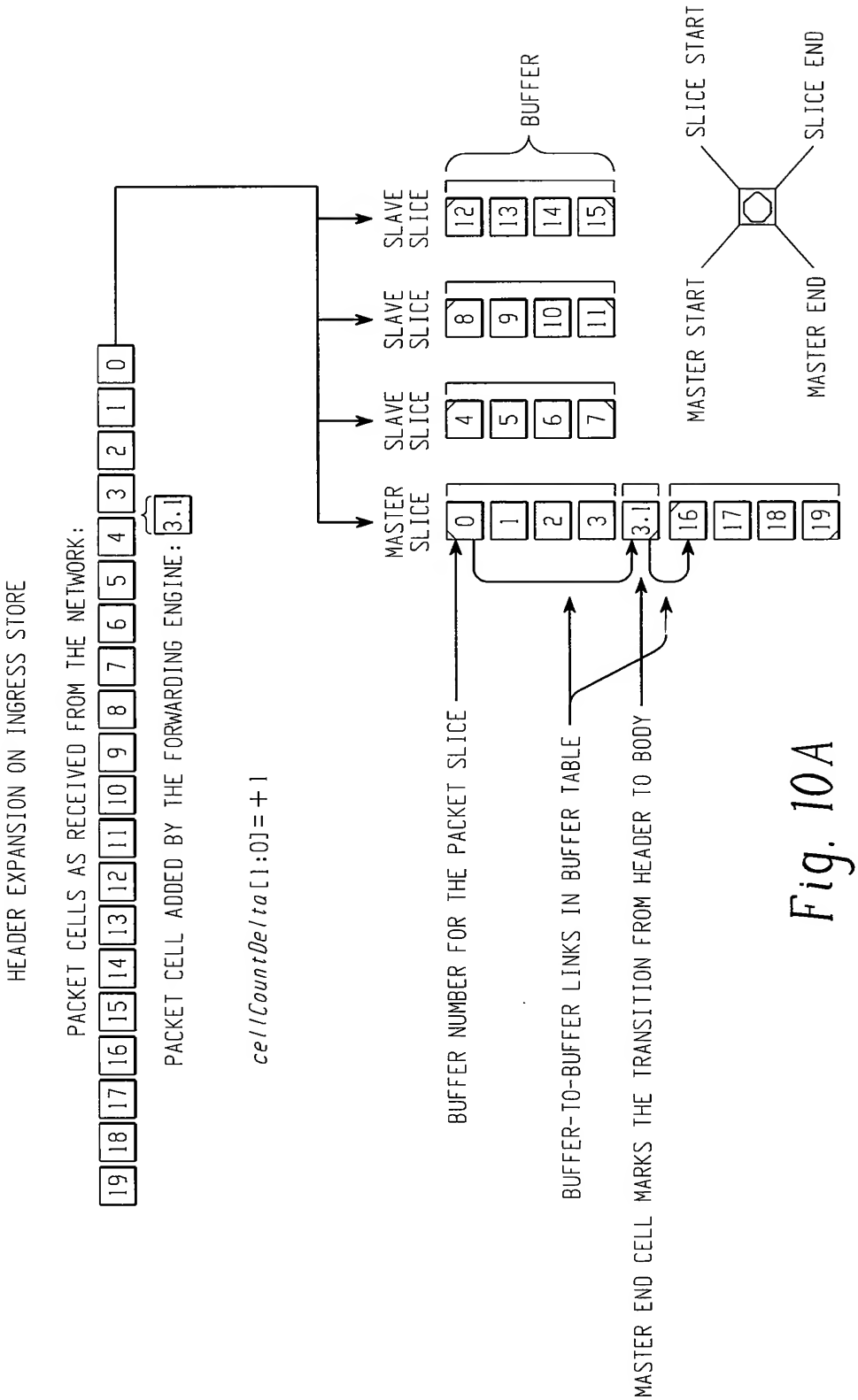
HEADER EXPANSION ON INGRESS STORE
PACKET CELLS AS RECEIVED FROM THE NETWORK:
19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
PACKET CELL ADDED BY THE FORWARDING ENGINE: 3.1
cellCountDelta[1:0] = +1
MASTER SLICE
SLAVE SLICE
SLAVE SLICE
SLAVE SLICE
BUFFER
0 1 2 3 3.1 16 17 18 19
4 5 6 7
8 9 10 11
12 13 14 15
BUFFER NUMBER FOR THE PACKET SLICE
BUFFER-TO-BUFFER LINKS IN BUFFER TABLE
MASTER END CELL MARKS THE TRANSITION FROM HEADER TO BODY
SLICE START
SLICE END
MASTER START
MASTER END

Fig. 10A

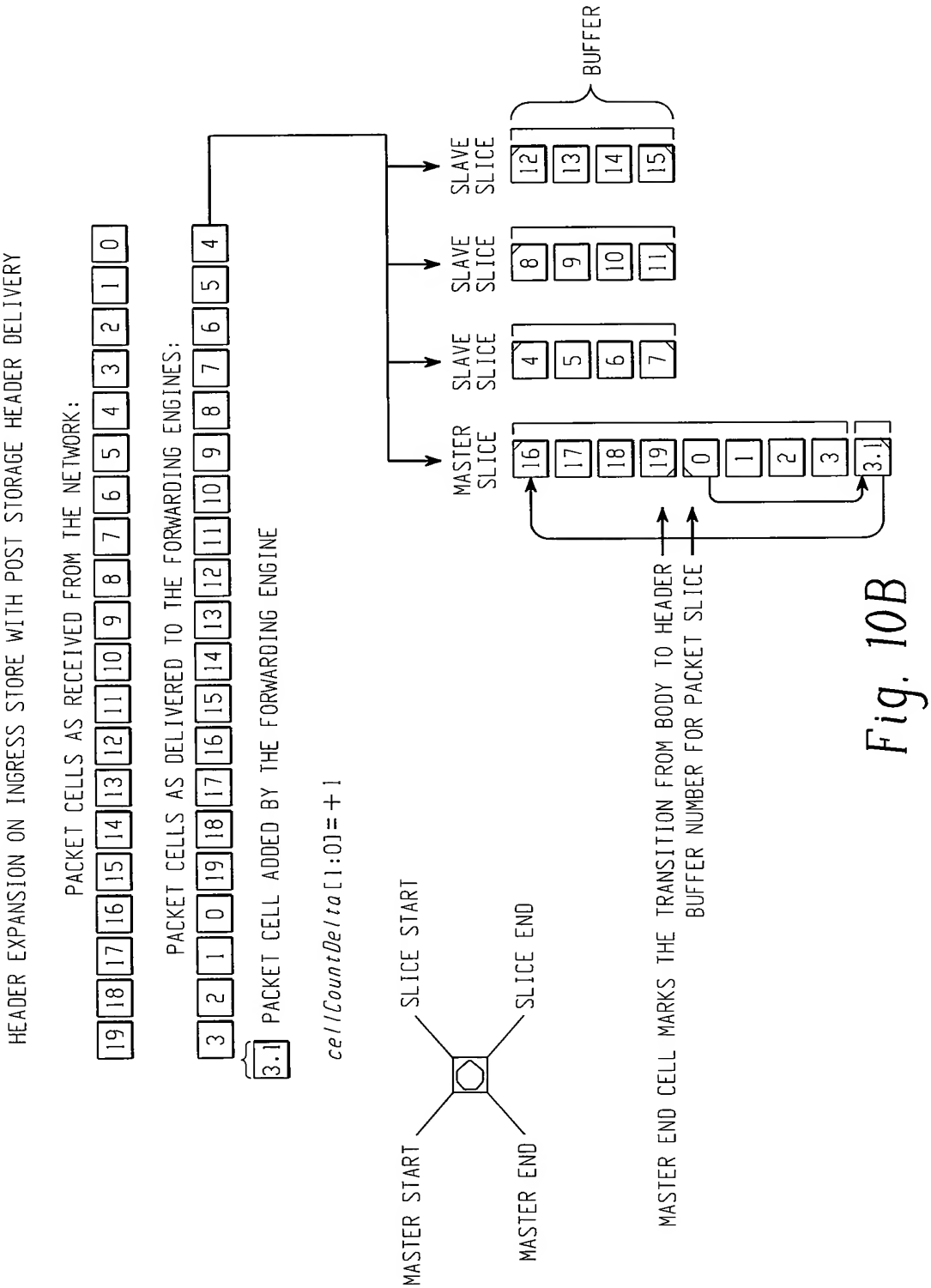
HEADER EXPANSION ON INGRESS STORE WITH POST STORAGE HEADER DELIVERY
PACKET CELLS AS RECEIVED FROM THE NETWORK:
19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
PACKET CELLS AS DELIVERED TO THE FORWARDING ENGINES:
3 2 1 0 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4
3.1 PACKET CELL ADDED BY THE FORWARDING ENGINE
cellCountDelta[1:0] = +1
SLICE START
SLICE END
MASTER START
MASTER END
MASTER SLICE
SLAVE SLICE
SLAVE SLICE
SLAVE SLICE
BUFFER
16 17 18 19 0 1 2 3 3.1
4 5 6 7
8 9 10 11
12 13 14 15
MASTER END CELL MARKS THE TRANSITION FROM BODY TO HEADER
BUFFER NUMBER FOR PACKET SLICE

Fig. 10B

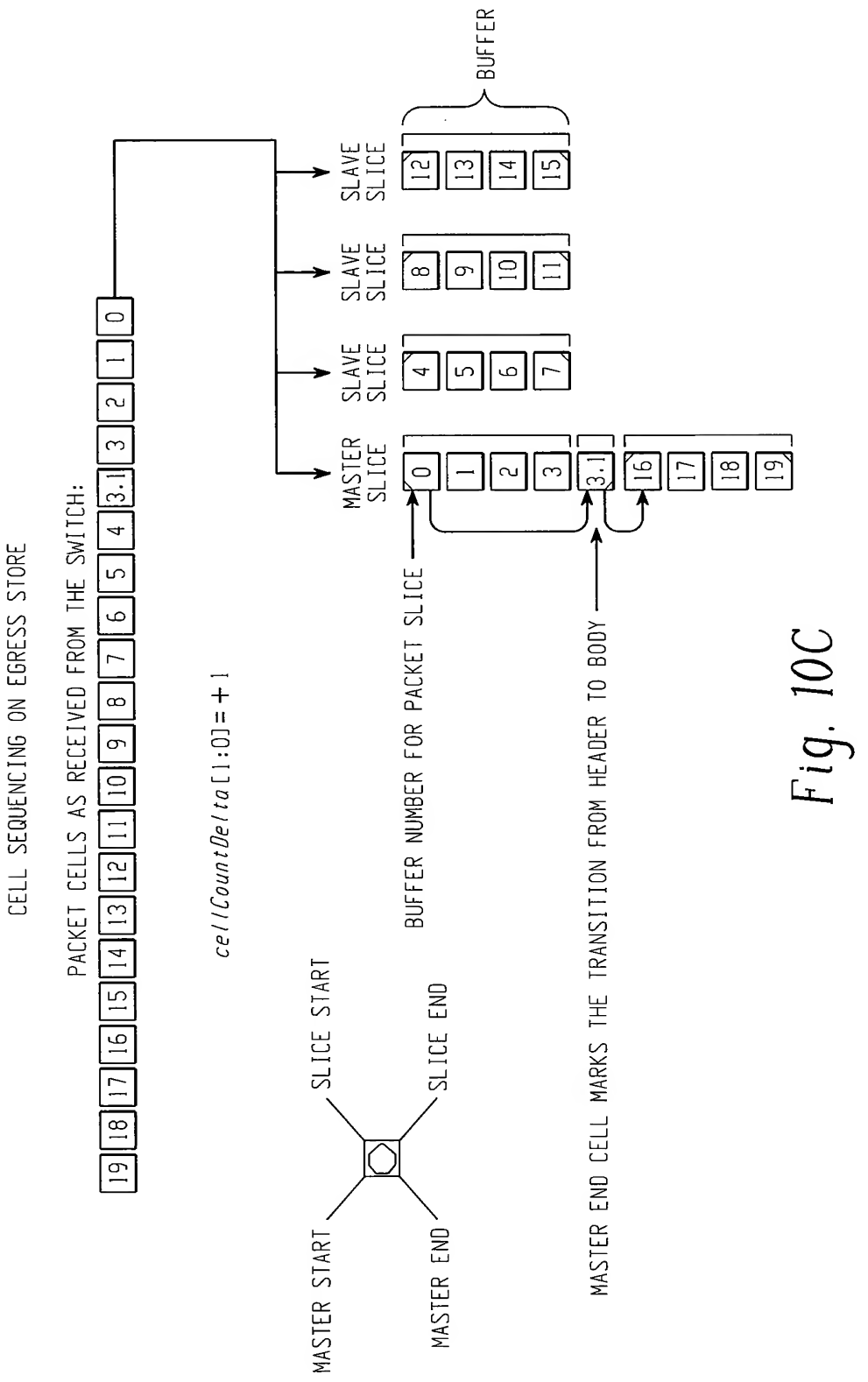
CELL SEQUENCING ON EGRESS STORE
PACKET CELLS AS RECEIVED FROM THE SWITCH:
19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3.1 3 2 1 0
cellCountDelta[1:0] = +1
MASTER SLICE
SLAVE SLICE
SLAVE SLICE
SLAVE SLICE
BUFFER
0 1 2 3 3.1 16 17 18 19
4 5 6 7
8 9 10 11
12 13 14 15
BUFFER NUMBER FOR PACKET SLICE
MASTER END CELL MARKS THE TRANSITION FROM HEADER TO BODY
SLICE START
SLICE END
MASTER START
MASTER END

Fig. 10C

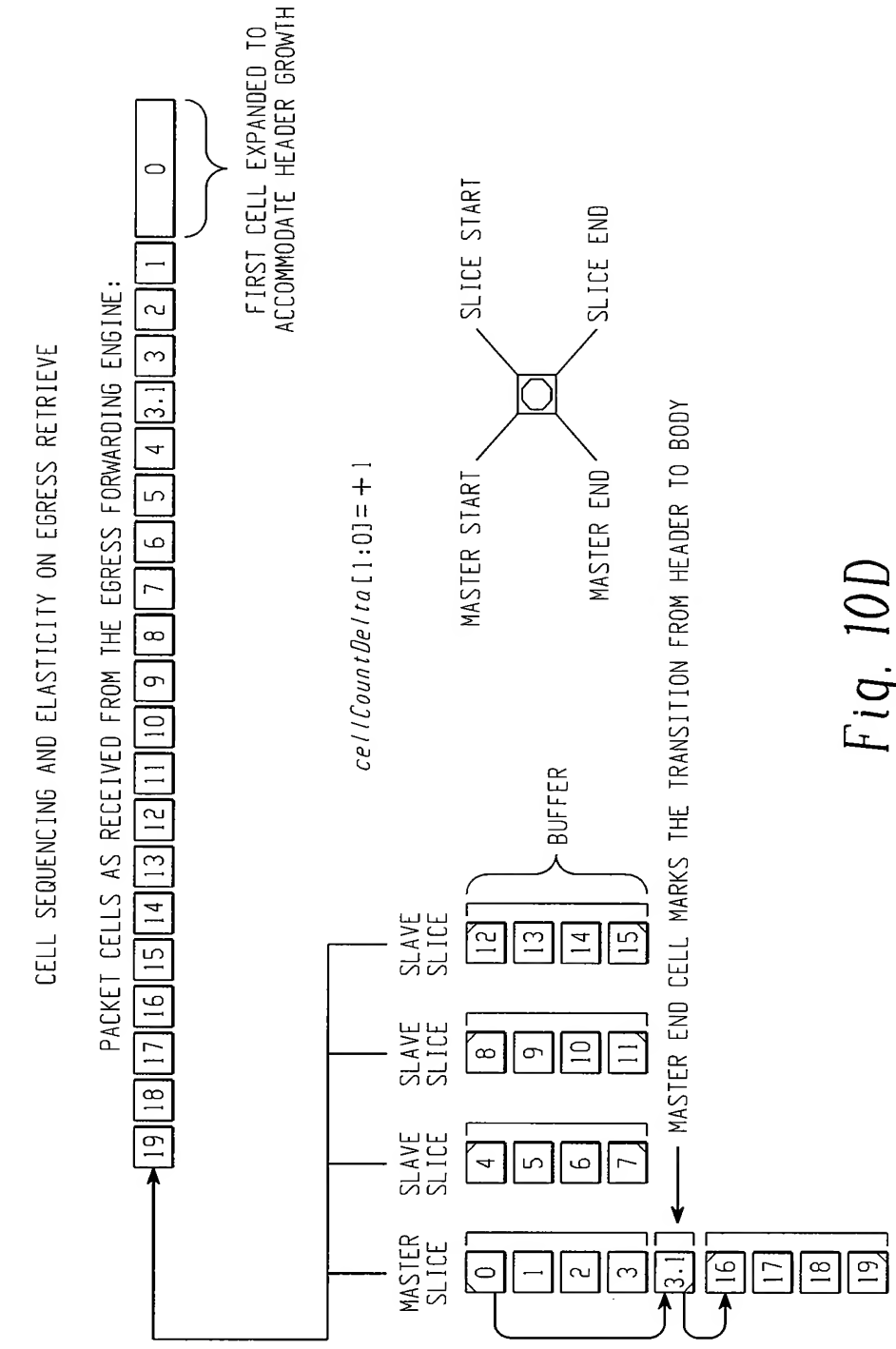
CELL SEQUENCING AND ELASTICITY ON EGRESS RETRIEVE
PACKET CELLS AS RECEIVED FROM THE EGRESS FORWARDING ENGINE:
19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3.1 3 2 1 0
FIRST CELL EXPANDED TO ACCOMMODATE HEADER GROWTH
cellCountDelta[1:0]=+1
MASTER START
SLICE START
SLICE END
MASTER END
MASTER SLICE
SLAVE SLICE
SLAVE SLICE
SLAVE SLICE
BUFFER
0 1 2 3
4 5 6 7
8 9 10 11
12 13 14 15
3.1 16 17 18 19
MASTER END CELL MARKS THE TRANSITION FROM HEADER TO BODY

Fig. 10D